Anesthesiologist's Point of View

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EVERYONE WILL AGREE that anesthesia, per se, has little to do with hyaline membrane formation. However, what happens after the administration of an anesthetic may affect both the mother and the baby. The very nature of the disturbances that may be produced may set the stage for hyaline membrane disease.

The onset of respiration in the newborn child sometimes can lead to a false sense of security in the physician. Whether by vaginal delivery or cesarean section, the baby is born and takes its first breath. But then sometimes five minutes later the infant has not taken his second breath. This occurrence of secondary apnea is a perplexing problem. To wait too long to correct it, exposes the infant to hypoxia.

The inability of some premature infants to continue breathing after the prompt onset of respiration may be due to anoxia, superimposed on the immaturity of the pulmonary capillary bed. Respiratory failure in the newborn is generally due either to central nervous system failure which leads to apnea, or to peripheral failure of the lungs or chest structures. The latter most frequently takes the form of hyaline membrane disease. In this condition, the infant breathes initially. Shortly after birth he begins to have respiratory distress manifested by progressive sternal and intercostal retraction and an increase in the respiratory rate. This gradually becomes worse during the ensuing 12 to 36 hours, going on to cyanosis, carbon dioxide retention, respiratory insufficiency, respiratory muscle failure and death.

Infants with hyaline membrane disease work hard to breathe. Despite all efforts they have inadequate gaseous exchange. The hyaline membrane material in the lung is fibrin and an important factor contributing to a fibrinogen exudate is the increased pulmonary capillary pressure. The respiratory center of the newborn and especially the premature infant cannot endure an extended period of hypoxia. Profound respiratory depression and apnea may also be a result of the combined effects of sedative, analgesic and anesthetic drugs, plus low pO_2 and high pCO_2.

Let us look for a common denominator somewhere. Babies are born prematurely. Babies are born of diabetic mothers and babies are born by cesarean section. Among the many indications for cesarean section are fetal distress, abruptio placenta and placenta previa. The common denominator, it seems to me, is whatever will produce fetal distress, whether it be in utero, during the pregnancy or during the process of labor, during birth itself, or anything immediately following. Pulmonary hyaline membrane disease is more common in premature than in full term infants. There is a disproportionately high incidence among infants of diabetic mothers and infants delivered by cesarean section. On the other hand, it is rarely seen in babies under 1,000 gm. or in babies that are either stillborn or who die within an hour after birth.

Whatever produces fetal distress supplies the prerequisite for any complication in the newborn including that of hyaline membrane disease. Any anesthetic, for example, that will produce hypotension or prolonged respiratory depression in the mother will produce anoxia in the infant. Hypoxia of the newborn is best minimized by adequate prophylaxis, namely, the avoidance of unnecessary depression caused by amnesic, analgesic and anesthetic agents.

We live in a peculiar time in our civilization. Despite the high degree of enlightenment and education, women are still unduly influenced by old wives' tales of the horror and pain of labor and delivery. Consequently, many women in labor are excessively fearful and lack an understanding of the psychological aspects of labor and delivery. We as physicians also contribute unwittingly to the dilemma pregnant women find themselves in, by a lack of awareness of the semantics of the situation. Who stops to ask "How often are your contractions?" Most of us say, "How often are your pains?" We suggest pain to our patients. Consequently the doses of analgesics and hypnotics that the average woman requires, especially if the baby is premature, are far and above what the mother really needs and what the infant can tolerate. All these factors again produce respiratory depression in the infant which can keep him in a period of apnea longer than would ordinarily be tolerated. I am certain that in many instances it may induce respiration in utero itself. Who knows but that respiration in utero, with amniotic fluid lodging in the lungs of the newborn infant, is responsible in some cases for hyaline membrane disease?

What can be done as far as resuscitation is concerned? Too vigorous resuscitation can be very damaging. For example, positive pressure used injudiciously can tear a lung. Not only the pressures of oxygen blown into the lung, but the time interval between the various inflationary cycles, are important. We are caught between the maximum of 40 per cent oxygen which cannot be exceeded in prematures lest retrolental fibroplasia develop, and what statistics show is the necessary percentage of oxygen to prevent and treat hyaline membrane disease—namely, 50 to 60 per cent. It may be that we do not need much oxygen at all. It may be that we

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are overlooking something like compressed air mixed with oxygen or helium mixed with oxygen, to give us greater volume to inflate the lungs without the additional oxygen and its possible detrimental effects.

I would say that atelectasis when it is due to immaturity is something we can do very little about. But atelectasis which is due to secondary apnea or profound respiratory depression in the newborn infant, resulting from over-narcotization or over-anesthetization of the mother, must be corrected immediately. If an obstetrician or pediatrician is skillful in inserting a tracheal catheter without a laryngoscope, this should be done. However, if it is going to be difficult, time should not be wasted in the establishment of an airway and the larynx should not be traumatized. The baby should be turned over to someone who can insert a catheter very quickly under direct laryngoscopic visualization. It must never be forgotten that there may be fluid in the tracheobronchial tree which, before the first inflation of the lung, must be aspirated so that whatever fluid there is, be it amniotic or gastric, is not blown into the lung. If necessary, the catheter may be withdrawn and then reinserted. I might call to your attention that in animal experiments, when hydrochloric acid was poured into the lungs of the animals, in many instances a condition similar to that of hyaline membrane disease was produced.

The alveolar ducts and alveoli of newborn infants may change from normal to abnormal in a very short time. It is possible that the process might be interrupted by energetic therapy. The only chances for reversal are either during or just after birth. Irreversible changes may be prevented by proper lung expansion and proper oxygenation. If a positive pressure device is to be used, although initial pressures up to 30 cm. (water) may be required for initial expansion, pressures should not exceed 15 to 20 cm. for more prolonged resuscitation. The most efficient pressure is that which produces adequate pulmonary ventilation. The prophylactic use of detergent mists has been recommended but the results leave much to be desired. Recently, the question of temperature control as a means of therapy has come under study. Cook recommended that hypothermia be used, but Silverman's study showed a higher survival rate in the group of infants that were kept warm.[1]

In conclusion, it may be stated that because of the immaturity of all the functions in the premature infant, particularly the respiratory center, the heat-regulating center and the fragility of the capillaries, there is a greater need for the more intelligent use of sedative, narcotic, analgesic and anesthetic drugs in the mother, and for gentler handling and more prompt recognition of distress in the newborn infant. Most authorities agree that the most hazardous period of life is the first 15 minutes. Hypoxia is the greatest danger. If we avoid maternal respiratory and circulatory depression throughout labor, the condition of the infant at birth will be unrelated to anesthesia and analgesia. There are innumerable methods of pain relief and no method or drug is any safer or better than the individual who uses it.

Hyaline membrane disease and atelectasis of the lung present the greatest challenge in prevention and in the immediate institution of therapeutic measures. While we have learned a great deal about this mystifying condition and a great deal of progress has been made, we still have much more to do and much more to learn before a cure can be hoped for. This challenge and these problems will be solved only through the cooperative efforts of research, the obstetrician, the pediatrician and the anesthesiologist.

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REFERENCE

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Internist's Point of View

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DR. KAGAN touched upon my study of fetuses and neonatal infants in which it was noted that eight infants dying of hyaline membrane disease had a defect in the fibrinolytic enzyme system of their lungs. This was manifest by an inability of lung tissue to activate plasminogen. Most human tissues normally contain a tissue-activator of plasminogen. Lung is unique in that this enzyme appears earlier during fetal development than in any other organ, and it is present most consistently and in the highest titres. The tissue-activator has been shown to reside within the mitochondrial and microsomal fractions of the cell, and to be relatively insoluble.

I postulated that this enzyme functions in the lysis of intra-alveolar fibrin deposits. The fibrin appears to result from an interaction of the natural clotting factors present in an effusion from pulmonary capillaries with the thromboplastin in amniotic fluid or that resulting from damage to lung tissue (lung contains a very high level of thromboplastin). The mechanism involved may resemble amniotic fluid embolism in that diffuse deposits of fibrin are formed within the small vascular channels as a result of the amniotic fluid embolus. The deposits of fibrin in turn are thought to stimulate activation of

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